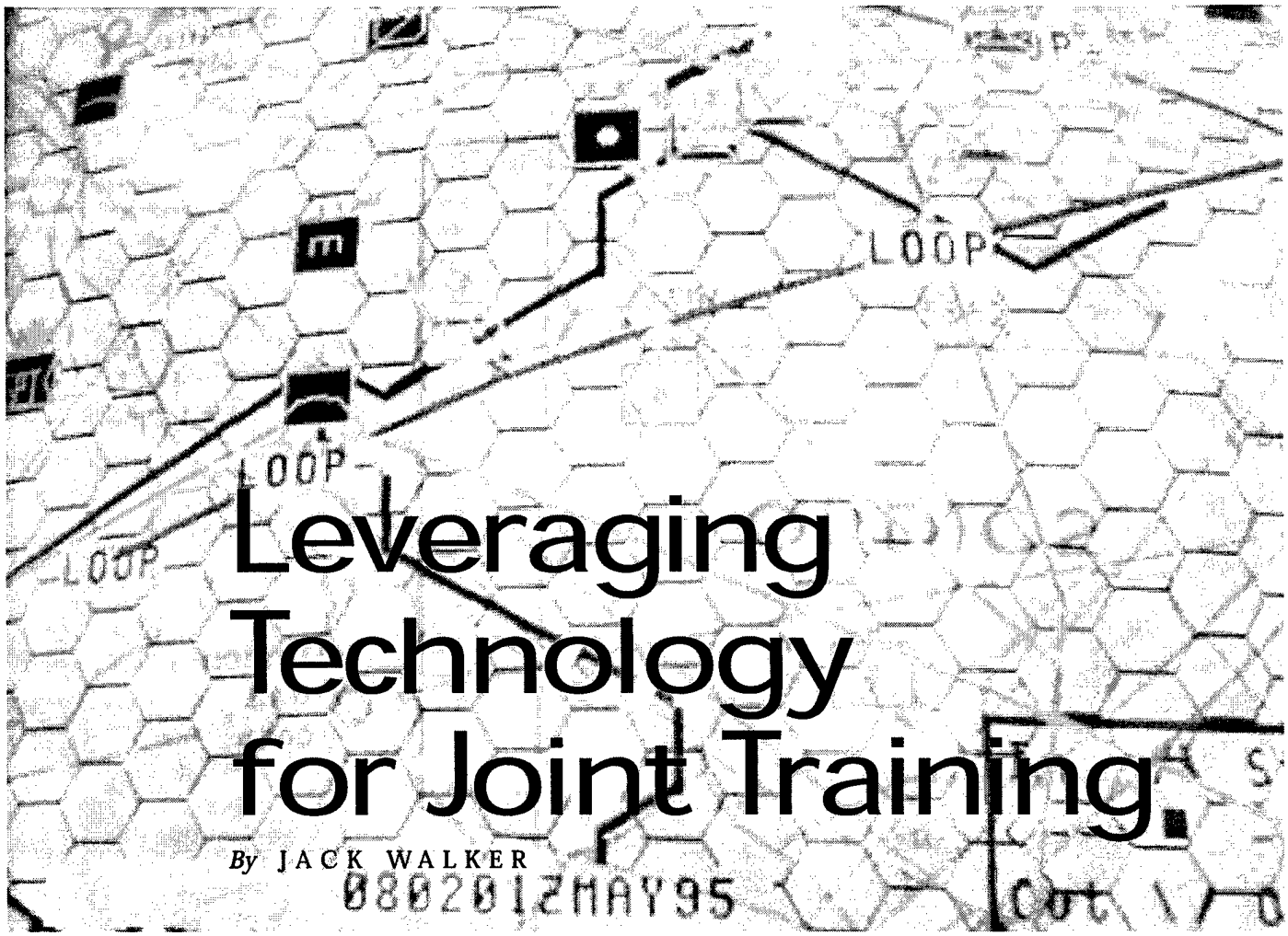

U.S. Army (Lance Cheung)

Leveraging Technology for Joint Training

By JACK WALKER

The promise of modeling and simulation for training is being fulfilled with the introduction of updated models. Better simulations are also on the way as object-oriented models—with greater flexibility and full interoperability—come on line in the next five years. But another revolution is occurring, albeit with less fanfare. It involves leveraging new educational technologies—beyond modeling and simulation—to meet the needs of joint education and training. While this innovation will have a significant impact on education and training, it will not fulfill its potential unless joint and component commanders understand what the technologies represent, what they can and cannot do, and how to integrate them into traditional instructional methodologies.

The technologies can control and reduce costs, deliver education and training on demand or just in time, tailor delivery to individual student needs with simultaneous language translation, provide training certification, reduce or eliminate safety concerns in hazardous training, and enable students to collaborate without leaving their duty stations; in some cases, they may fully participate from home. When these technologies are integrated with models, simulations, and more traditional classroom methods the payoff will be better trained joint and combined forces.

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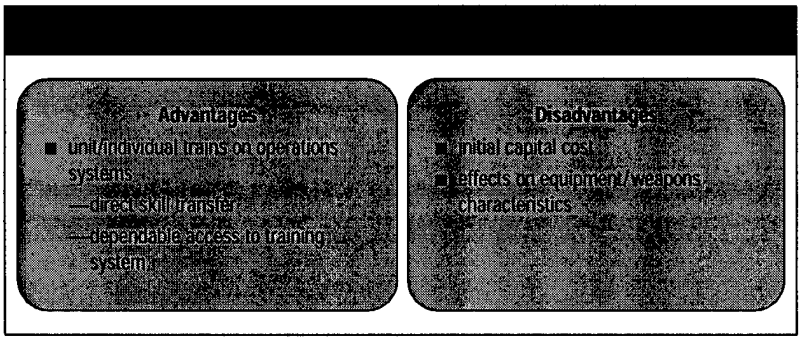
Technologies and Applications

Although there is no generally accepted taxonomy of educational technologies, they can be classified as embedded training, computer-based instruction, distance learning, and hybrids. One area in which the military is ahead of industry is embedded training, which is defined as a training capability designed or built into operational systems. Its key feature is allowing participants to use the same equipment in training as is employed operationally. Rather than practice tank gunnery on a simulator, for example, embedded



training permits the tank crew to practice in their assigned tank with little or no external support. In effect the tank becomes a simulator and the crew gets instant feedback on their performance.

While each service emphasizes embedded training—the current Chief of Staff, U.S. Army, has stated that all new systems must have embedded simulation—the Navy Aegis combat training system (ACTS) is especially impressive since it permits full-up training of the Combat Information Center team on the Aegis system at sea or in port. In addition to team training, individual operator training is also embedded in the ACTS lesson control program.

Embedded training offers many advantages over a stand-alone simulator, including access by a training audience and the direct transfer of the learning experience from training to operations. But embedded training initially can be more expensive since the system components must be engineered to withstand the same physical conditions as the operational system. Also, the additional weight of the training system can affect range and fuel consumption, a significant consideration for aircraft. Moreover, the training may not require a simulator for each operational system.

interactivity is one key to successful computer-based instruction

Computer-based instruction generally includes a broad range of hardware and software; the term is usually synonymous with computer-based training. Although computer based-instruction has been around for more than a decade, recent excitement over its vast potential and application to a wide audience is related directly to the proliferation of multimedia personal computers. These computers with powerful processors and built-in audio and video are found in most military units and many homes. No longer must computer equipment be procured exclusively for instructional purposes. Instead, computers devoted to administration, operations, and logistics can be used for individual and collective training. This means managers of education and training programs who are considering the development of computer-based instruction often do not have to factor in the considerable initial capital outlay to buy hardware but can devote their limited resources to courseware development.

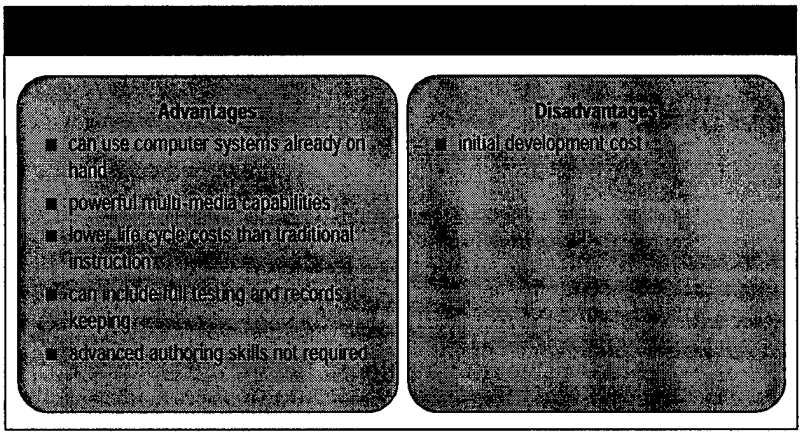
Computer-Based Instruction

A common way of delivering computer-based instruction is compact disks (CD-ROMs). Cheaply reproduced and with a large capacity for storing data, CD-ROMs permit the incorporation of audio and video into computer-based instruction, moving the standard from simple page turning (consisting of text and graphics) to multimedia applications with sound, graphics, animation, and video reinforcing the learning experience. The results: lessened training time, increased retention, consistent presentation, and enthusiastic students.

When pre- and post-test and records management functions are included, computer-based instruction allows students and trainers to diagnose individual needs (preventing the waste of time on instruction with which students are familiar), test mastery of content to the required standards, and even report course progress, completion, and difficulties with courseware or content to course managers. Even better, the availability of graphical course authoring software, such as *Toolbook*, permits the computer-literate (not only programmers) to learn quickly to create courseware (though functions such as records management and advanced animation require programming familiarity). For several years the Air Command and Staff College has provided both faculty and students with the opportunity to do just that, and its graduates depart with CD-ROMs containing useful tools and tutorials created by faculty and students.

Interactivity is one key to successful computer-based instruction. Well-designed interactive courseware reinforces learning and requires students to participate via a graphical user interface that allows students to intuitively navigate

through courses and use computers without having to know much about them. And students set the pace of instruction with the freedom to interrupt it at any time and return to the same point when desired (bookmarking).



A major concern with computer-based instruction is the up-front investment for design and development. There is no accepted rule of thumb for comparing the cost of developing interactive courseware with platform instruction. But what is certain is that the cost of repeatedly delivering platform instruction—for faculty and student time, per diem, and overhead—quickly pays for the initial investment in courseware. In the case of one joint education project, the life cycle cost of presenting a 30-hour program of instruction in a classroom was four times the estimated outlay for delivering it on CD-ROM, including development. Well-designed courseware is easily updated as the content changes. While application of this technology is powerful and has been demonstrated, its educational use—especially in professional military education—is only now being recognized. This challenge offers the possibility for tremendous payoffs in joint and combined warfare.

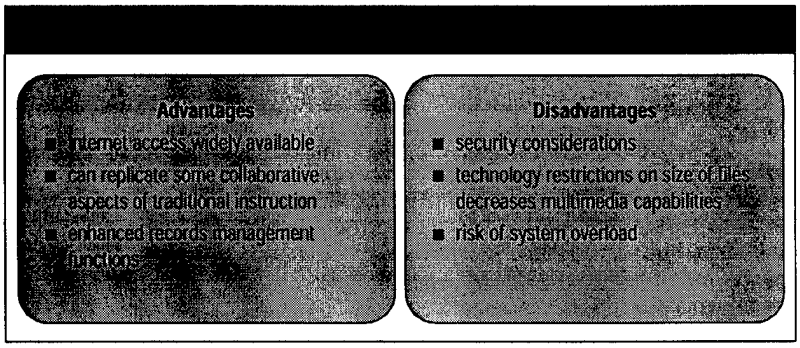
Education involves both cognitive learning (knowledge) and affective learning (attitudes) and attempts to prepare students to face situations and solve problems not yet defined.[1] Computer-based instruction can contribute to education as well. One important application is in the area of knowledge levelers, interactive courseware which ensures that all students are at a baseline level of knowledge and proficiency before beginning expensive resident education. Joint professional military education institutions and intermediate and senior service colleges which draw students from all services and varied experiences could benefit tremendously from this kind of application, as could institutions involved in multinational educational programs.

Another technological contribution to joint training is focused on the U.S. Special Operations Command, which has the task of providing special operations forces (SOF) professional military education to more than forty thousand personnel serving around the world with unified commands. Recently the Joint Special Operations Forces Institute began developing a program for a series of fully interactive multimedia courses, initially delivered on CD-ROM.

Various technologies can be grouped under the rubric of distance learning, broadly defined as instruction without the physical presence of a teacher, from traditional correspondence courses to audio and video conferencing. Much of the interest in this area involves using the Internet and intranets to deliver instruction. Although there are many examples of educational and training uses of the Internet, perhaps the most ambitious is an effort by the governors of 18 western states to use the Internet to create a "virtual university"—the Western Governors University.

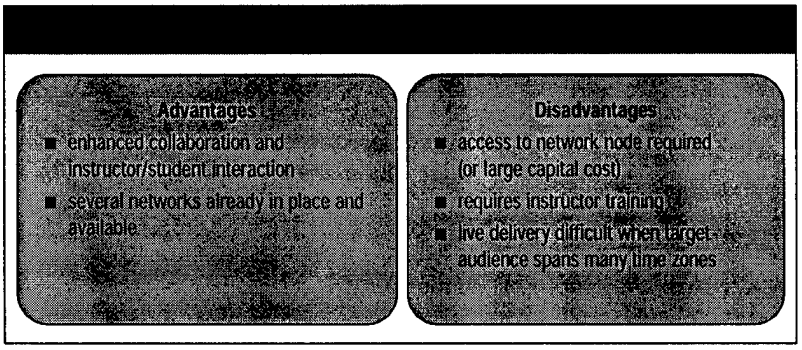
Distance Learning

Not surprisingly, there is excitement in military education and training circles over distance learning. Using the Internet as a means to deliver courseware allows students to participate from their duty stations or homes. Internet access is becoming increasingly available and inexpensive, and the hardware requirements are minimal; in fact, it is difficult to purchase a personal computer today without a modem or network card (hardware necessary to access networks like the



Internet). The Internet is becoming a powerful research tool, so courseware which uses it for delivery can also take advantage of its research capabilities. And Internet courseware authoring languages are available that automatically track student performance and provide course directors with formatted, pre-addressed electronic mail messages to encourage student progress.

The most obvious disadvantage of the Internet in delivering military courses is the lack of available, reliable, easy-to-use security.[2] The Defense Information Systems Agency has estimated



that there were some 250,000 "attacks" on DOD computer systems in 1995.[3] For the time being, only unclassified (non-sensitive) courses should be considered for Internet delivery. Even with passwords and other measures to secure access to courseware sites, hackers could electronically penetrate any Internet site and damage files or compromise records.

As with all forms of distance learning, interaction among instructors and students is limited on the Internet, although as bandwidths increase and hardware improves, the impact of these limits may be diminished. Furthermore, currently available combinations of bandwidth, computers, and communications hardware and software severely constrain the size of files that can be downloaded quickly—and this means a judicious use of animation, video, and sound in Internet courseware.[4] Studies show that students lose patience when they have to wait more than twenty seconds for the next screen. Since audio and video files can take several minutes to download, for the next few years at least most Internet-delivered instruction will consist primarily of text and still graphics. And finally, some experts believe that the future viability of the Internet itself is at risk as global demand for access increases geometrically each year.

video teleconferencing can provide collaborative aspects missing in other educational technologies

Other distance learning includes audio and teleconferencing, with instructors appearing live or on tape. Among them are the Navy CNET electronic schoolhouse network (CESN), a two-way multipoint secure video and audio network; the government education and training network, a one-way video, two-way audio satellite-based system; and the Army teletraining network, a two-way audio and video structure with connectivity to CESN. Depending on the network and hardware, video teleconferencing can provide collaborative aspects missing in other applications of advanced educational technologies. But unlike CD-ROMs, students must avail themselves of training when it is scheduled rather than when it is personally convenient. This is a problem when the segments of a training audience are separated from each other or from the source of instruction by many time zones. Moreover, unless an audience has access to a network site, the capitalization cost of this form of distance learning can be prohibitive. And instructors must be specially trained in order to understand its capabilities and limitations.

Some problems associated with technology can be overcome by hybrid combinations. For example, interactive multimedia CD-ROMs are being produced with basic courseware that includes Internet connections in the software. This allows students to download updates, research topics in depth, or communicate with course managers. Both performance testing and records management functions can also be accomplished. A related hybrid application will combine Internet-based instruction with Internet-based teleconferencing.

Hybrid Applications

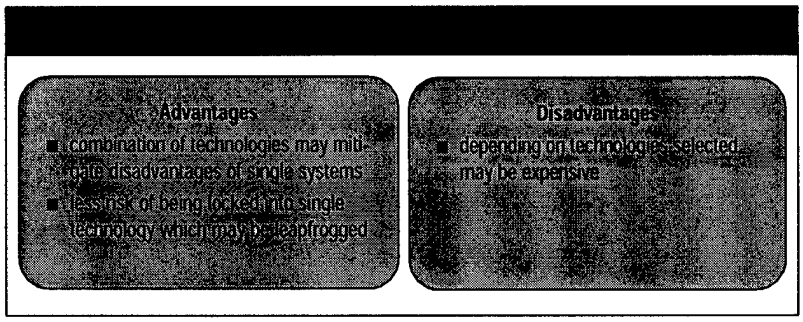
It is possible to replicate collaborative aspects of seminar-based instruction by designing simulations (via CD-ROM) in which computers in essence play other parts. Such collaborative simulations may be expensive to develop but are tremendously effective. The disks can be tailored to allow students to play many roles and can illustrate the effects of actions on virtual players.

Computer smart tutors can also provide some interaction with instructors missing in simple page-turner computer-based instruction. An example of this potential is the S2 trainer, a simulation on CD-ROM developed by Northwestern University to train National Guard battalion intelligence officers.[5] Students working individually on personal computers act as intelligence officers and are provided planning guidance by the battalion commander and operations officer. Moreover, they plan a tactical operation and complete an intelligence estimate. Responses trigger video and audio clips in which subject matter experts suggest alternative approaches and relate relevant

anecdotes, in effect getting an instant, on-line after action review. A similar program for brigade operations officers is also under development.

Successful Applications

Those responsible for joint education and training programs should keep a few simple rules in mind in considering how to best integrate this confusing array of educational technologies.



"If you build it, they will come" works best on baseball diamonds and interstate highways, not in education and training. Often, especially when unanticipated funds becomes available, there is a strong trend to buy hardware, believing that courseware can always be developed later. This can result in impressive technical capabilities with little or no content. Instead, courseware design and planning for necessary hardware should be integrated in a single vision.

"Put this course on a CD-ROM" is a great way to create bad courseware. The strengths of new educational technologies are only realized when courses are designed from the outset to match educational objectives with methods of delivery for target audiences. Although courses often are digitized, the most effective way to capitalize on one's investment is by involving professionals in instructional systems design—the systems approach to training—at the outset. Early participation by those trained in systems design during the definition and analysis phases will help specify the need for programs, clarify education and training objectives, analyze an audience and the learning and resource environment, and develop a strategy to leverage technologies to meet requirements. The old adage—garbage in, garbage out—applies. CD-ROMs may just store more garbage.

Clicking the "next page" button doesn't make a course interactive. Adult learning theories point to the fact that most adults learn better in an active rather than passive environment; they must perform tasks to reinforce the lessons. Well-designed courseware requires the learner to participate frequently in the process and control the pace and sequence of instruction.

The Betamax was better than VHS but where is it now? For other than technical reasons VHS came to dominate the video market. The pace of change, especially that involving computers, makes it not only difficult to predict when hardware or software will be developed but the direction which major changes will take. Large capital investments in a single educational technology are problematic because of the risks of obsolescence.

Whether we recognize it or not, the next generation is here in the lieutenants, junior NCOs, and privates whose familiarity with computers, video games, and other technologies makes them bored with passive learning. Moreover, we are moving toward a military with more electrons but fewer people. Education and training demands will increase, especially in the joint arena, as force size declines. The answer must be career-long learning that leverages appropriate technologies to create and sustain high-impact, cost-effective education and training.

And there is more over the horizon. For example, DOD is examining generation after next collaboration, visualization, and information management technologies, many with applications for education and training. Joint commanders will face the challenge of sifting through technological glitter, looking for those few nuggets that can pay off in a well-trained, ready force. **JFQ**

NOTES

[1] Perhaps the best practical discussion of the differences between education and training is contained in volume 10, "Application to Education," of Air Force Handbook 36-2235, *Information for Designers of Instructional Systems* (November 1, 1993).

[2] The secret Internet protocol router network may resolve some of these concerns as it becomes more widely available.

[3] U.S. General Accounting Office, *Information Security: Computer Attacks at Department of Defense Pose Increasing Risks*, report AIMD 96-84 (May 1996).

[4] An excellent (and humorous) example of using the Internet for education and training can be both seen and heard at http://www.sageinteractive.com/overview.html. Note that these files can take several minutes to download.

[5] For a description see http://www.ils.nwu.edu/~vantomme/S2/S2Top.html.

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